



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Log 1943

Date: April 24, 1987

In reply refer to: A-87-38 and -39

Honorable Donald D. Engen
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On April 7, 1986, the flightcrew of a Crossair (Swiss Airline) Saab-Scania SF-340 aborted a takeoff from Basel, Switzerland, when they observed abnormal readings on the right engine torque meter, and felt the airplane yaw to the left. The captain aborted the takeoff by retarding the power levers (PL) to ground idle. When he heard the screaming sound of a runaway engine he immediately decided to shutdown both engines and moved the Engine Condition levers (CL) to the fuel cut-off position; simultaneously, the flightcrew heard a loud explosion and noticed an engine fire warning light. There were no injuries as a result of this incident. After evacuating the airplane, the first officer observed an engine tailcone and other engine parts scattered on the runway behind the No. 2 engine.

Because the Basel, Switzerland, airport is physically located on French territory, the French Bureau Enquetes Accidents (BEA) assumed responsibility for the accident investigation in accordance with International Civil Aviation Organization (ICAO) procedures. The National Transportation Safety Board appointed an accredited representative to the investigation panel. The Safety Board also represented the BEA on April 12, 1986, during a teardown of the engine and at a briefing on May 1, 1986, at the General Electric Company, Lynn, Massachusetts, (GE).

The right engine was a GE turbo-propeller model, CT7-5A2, serial 367131, with 2,170 total operating hours. Preliminary investigation at Crossair's hangar indicated that the engine had experienced an uncontained failure within the power turbine (PT) section of the engine. The failure resulted in damage to the right engine nacelle, right wing de-icing boot, right wing to fuselage fairing panel, and penetration of a nearby hydraulic line. Also the fuselage was punctured below the floor panel, and two small pieces of stage-4 PT blade material were recovered from below the cabin section of the airplane.

Engine teardown at the GE Company revealed that the PT shaft fractured immediately forward of the stage 3 turbine disk-mounting flange which resulted in massive damage to the PT module. Although damage was extensive, the two PT disks did not fracture or separate and were contained within the engine. Subsequent investigation disclosed that the PT shaft failed after the engine experienced an uncontrolled acceleration to an overspeed condition. Spectral analysis of engine sounds recorded on the airplane's cockpit voice recorder (CVR) and supporting data recorded on the digital flight data recorder (DFDR), indicate that the PT shaft reached a speed of about 152

percent of its rated RPM. Further investigation disclosed that the abnormal performance of the engine during takeoff and subsequent uncontrolled acceleration were attributable to an aberrant electrical signal in the engine control system. The aberrant signal was caused by moisture contamination of an electrical connector at the PT speed/torque sensor. Because of the contamination, the voltage of the PT speed feedback signal to the engine control unit (ECU) was reduced. The PT speed feedback signal provides intelligence to the ECU for propeller governing and to the fuel control to limit engine minimum speed when the power lever (PL) is retarded. This function is termed "bottom governing." In this incident the ECU sensed a lower than actual PT speed and thus called for the operation of a torque motor (T/M) in the propeller governing mechanism to reduce propeller pitch to a zero blade angle. This permitted the engine to overspeed uninhibited by propeller air loads.

Subsequent to the Crossair incident on April 7, 1986, GE and Saab-Scania issued communications between April 25, and June 9, 1986 to all SF-340A operators which described actions that could be taken to prevent an uncommanded engine acceleration as experienced by the Crossair crew. The communications included the following:

GE issued two telex messages which recommended: (1) cleaning and sealing the affected connector externally with a room temperature vulcanizing rubber (RTV), and (2) emphasized the use of T/M lockout, but cautioned the operators of the loss of certain desirable operational features when the bottoming governor is disabled.

Saab-Scania issued two operators messages which advised the operators of SF340-A airplanes about the history of, and potential for, an uncommanded and uncontrollable engine acceleration during takeoff; the messages also provided procedures to lockout the T/M and thus disable the bottoming governor. A second message provided for incorporation of the provisions of a service bulletin as an alternate means of disabling the bottoming governor.

Compliance with the above communications, as applicable, would result in the following:

- a. a loss of the constant torque on takeoff (CTOT) feature;
- b. reduced effectiveness of reverse thrust;
- c. a loss of the anti-ice function due to generator dropout at low idle speed; and
- d. a loss of the engine speed avoidance range protection feature.

On May 13, 1986, the New England Region, Federal Aviation Administration (NER-FAA) issued Telegraphic Airworthiness Directive (TAD) No. T86-10-51 to all operators of GE CT7-5A turbo-propeller engines installed in Saab-Scania SF-340A airplanes. Compliance with T-86-10-51 would prevent engine PT overspeed and resulting uncontained engine failure caused by an adverse reaction of the fuel control to an erroneous PT signal during ground operation when the bottoming governor is enabled. Essentially, the TAD directed a change to the "Normal Procedures" section of the Aircraft Flight Manual (AFM) by instituting a revised start and ground operating procedure for the airplane.

On October 3, 1986, GE presented to NER-FAA service bulletin (SB) (CT7-TP Series) No. 74-09, as a final fix for the engine overspeed problem. The SB recommended a minor wiring change to the engine control system and replacement of the existing propeller overspeed governor with one that has been modified to incorporate a redundant speed-

sensor switch. Incorporation of this SB would permit use of the bottoming governor and would also eliminate all restrictions currently imposed on the bottoming governor when complying with TAD T86-10-51. To eliminate the need to seal the present connector GE will eventually release a new design connector for production and service use.

On October 14, 1986, the NER-FAA approved the changes proposed by GE service bulletin (CT7-TP Series) No. 74-09 and its supporting documents. Although the SB recommends compliance at the next opportunity (without interference with flight operations), U.S. operators could continue to operate under the provisions of TAD No. T86-10-51 and the interim changes proposed by GE and Saab-Scania for an indefinite period, providing they accept the operational restrictions imposed by these documents.

The Safety Board believes that an operational procedure which eliminates the use of reverse thrust, CTOT, and other desirable features, and which could be subject to human error should not be relied upon to correct this condition when the engine manufacturer has developed and obtained FAA approval of a final fix to the problem.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an airworthiness directive that would make compliance with General Electric service bulletin (CT7-TP Series) No. 74-09 mandatory on all General Electric CT7-5A2 engines installed in Saab-Scania SF-340A airplanes at the next opportunity, not to interfere with flight operations and not to exceed 120 days, and concurrently, supersede and cancel Telegraphic Airworthiness Directive (TAD) No. T86-10-51. (Class II, Priority Action) (A-87-38)

Notify the appropriate foreign civil aviation authorities and foreign operators of SF-340A airplanes equipped with General Electric CT7-5A2 engines of the actions taken by the Federal Aviation Administration to preclude any further power turbine uncontained overspeed failures. (Class II, Priority Action) (A-87-39)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.


By: Jim Burnett
Chairman